

# Treatment of Asymptomatic Unruptured Intracranial Aneurysms

## A Clinical Decision Analysis

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### Summary

*The indication of preventive surgery for patients who harbor asymptomatic unruptured intracranial aneurysms remains controversial. To evaluate the benefit of this treatment, we investigated the management outcome in 128 patients with 157 unruptured aneurysms. Surgery was planned in patients 70 years old or younger without serious systemic complications. A total of 77 patients underwent surgery including four endovascular interventions, and conservative management was chosen in 51 patients. There was no mortality and 6.5% morbidity as postoperative results, and no complication was found after endovascular treatment. Among the patients in conservative management, four patients suffered from subsequent rupture during the total follow-up period of 148 person-years. The annual rupture rate was estimated at 2.7%. According to the clinical decision analysis based on our data, preventive surgery is beneficial for a Japanese 70 years old or younger. However, the expected utility decreases if the rupture rate is set at 0.5% or 0.05%, posing a doubt about the benefit of the surgery. Decision analysis pro-*

*vides an aid for logical and objective choice in the management of unruptured aneurysms. The actual risk of rupture has a major impact on decision making in therapeutic strategy.*

### Introduction

There is still controversy about management for asymptomatic unruptured intracranial aneurysms. Thanks to prevalence of MR apparatus in Japan, there are many opportunities for Japanese to undergo brain checkup by which unruptured intracranial aneurysms are frequently revealed. Appropriate management strategy should be established in these asymptomatic patients. The authors investigated management outcome in asymptomatic unruptured aneurysms, and applied clinical decision analysis to evaluate the validity of surgery for prevention of rupture.

### Material and Methods

A retrospective study was conducted among 128 patients with 157 unruptured intracranial

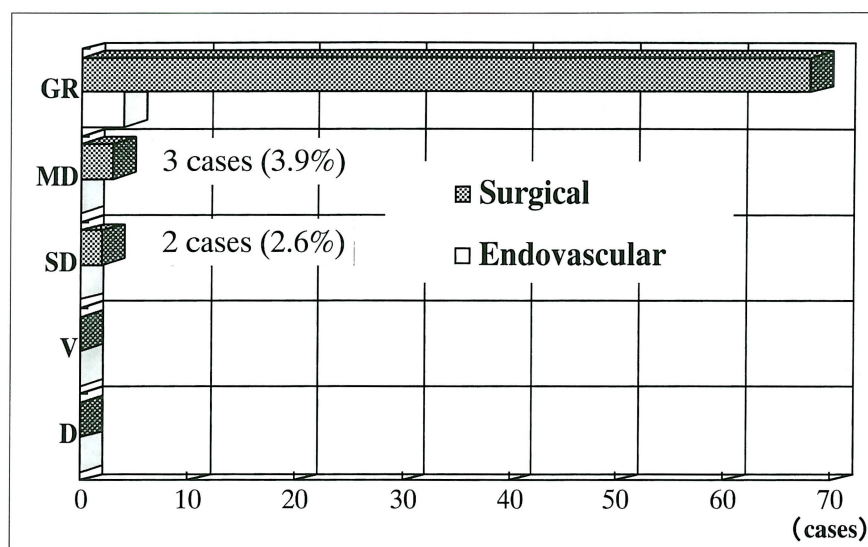


Figure 1 Surgical outcome in 77 patients with asymptomatic unruptured aneurysms.

GR = good recovery; MD = moderate disability; SD = severe disability; V = vegetative; D = dead

unruptured aneurysms. These patients were managed according to the following principles: 1) Surgical neck clipping is indicated for aneurysms located in the anterior circle of Willis. 2) Endovascular treatment or surgical ligation/entrapment is considered for aneurysms in the vertebrobasilar system or arising from the paraclinoid internal carotid artery. Therapeutic results were evaluated with the Glasgow Outcome Scale. Rupture rate was calculated based on the data from the patients who underwent conservative follow-up. Usefulness of preventive surgery was appraised using clinical decision analysis.

## Results

### Management outcome

Among a total of 128 patients, preventive treatment was performed in 77 patients (60%: group A), including four who underwent endovascular embolization. In 51 patients (40%: group B) conservative observation was preferred because of advanced age (28%), refusal of treatment (24%), high risk in treatment (20%), poor physical conditions (12%), and other reasons (16%). The mean age was 56.0 years in group A and 61.9 years in group B. Females were predominant in both groups.

Therapeutic results were shown in figure 1. There was no surgical mortality, whereas postoperative neurological deficits occurred in five patients (6.5%). Such morbidity resulted from

complicated surgery including bypass combined with carotid artery occlusion. Results after endovascular embolization were excellent in all patients. The patients in group B underwent conservative therapy including blood pressure control, and four patients among them suffered from subsequent rupture during 148 person-years. The annual rupture rate was estimated to be 2.7% per year. Clinical features in these patients were summarized in table 1. The size of ruptured aneurysm was 10 mm or larger, and bleeding was commonly seen in elderly patients.

### Clinical decision analysis

Clinical decision analysis<sup>2,3</sup> was conducted to appraise the validity of treatment for unruptured intracranial aneurysm objectively. A 70 year-old female with an unruptured aneurysm was taken for example as a borderline patient for surgery. Possible options for the patients were shown in the decision tree (figure 2). The decision node (square) denotes the choice of whether or not to undergo surgical treatment, and the chance nodes (circles) represent the events that may follow this choice. Quantitative values were assigned from our postoperative results as 0% mortality and 6.5% morbidity, and the data relevant to global management outcome after subarachnoid hemorrhage were also assigned from the literature<sup>4</sup>. Utility was assigned as follows: 100 for state in good health, 75 for state with disability and 0 for death.



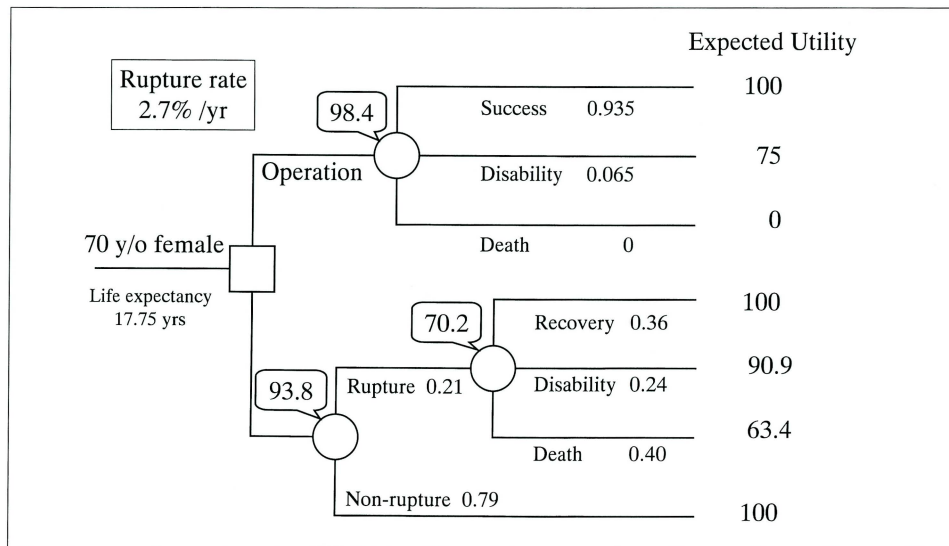


Figure 2 Decision tree in a 70 year-old female with asymptomatic unruptured aneurysm.

Yearly discount rate was set at 5%. The life expectancy of this patient was assumed as 17.75 years from the official statistics<sup>5</sup>. The probability of events and the utility of outcomes were multiplied and folded back, resulting in an expected utility (EU) for each option. The EU of surgery was 98.4, and that of conservative management was 93.8. Surgery reduced the loss of utility of 6.4 caused by an incidental aneurysm to 1.6, which meant a loss of 0.28 year instead of 1.1, because the life expectancy of this patient was 17.75 years. In a 70-year-old male (life expectancy: 13.62 years), the EU of conservative treatment was estimated at 94.4, while that of surgery was the same (98.4). Then the sensitivity analysis was performed using the presumable range of annual rupture rate<sup>6</sup> for the 70 year-old female. When the rupture rate was 0.5% per year, the EU of conservative treatment increased to 98.7. Meanwhile that of surgery remained same (98.4), implying that conservative management was slightly beneficial than surgery. The EU rose to 99.9 when the annual rupture rate was 0.05% (table 2).

## Discussion

Controversy still remains about surgical treatment for unruptured intracranial aneurysms. Though these aneurysms may cause hazardous rupture in future, even the recent advancement of microneurosurgical technique has not eradicated postoperative morbid-mortality. The annual rupture rate in unruptured

aneurysms was estimated at about 1% previously<sup>7,8,9</sup>. However, the international study<sup>6</sup> in 1998 reported a lower risk of rupture from a large series of patients. This study<sup>6</sup> has so far made a considerable influence on management of unruptured aneurysms. Clinical decision analysis provides a clue to solving complicated problems. While decision analysis has inherent limitations and cannot substitute clinical reasoning, the validity of the conclusions can be examined by sensitivity analysis.

Most critical factors for surgical indication are risk of rupture and postoperative morbid-mortality. Our analysis demonstrates that preventive surgery is justified for a 70 year-old Japanese or younger. The result is applied for the following condition: annual rupture rate is 2.7% and operation is performed with 0% mortality and 6.5% morbidity. The lower the risk of rupture as reported in the International Study<sup>6</sup>, the less benefit is obtained from surgery (table 2). Actual risk of rupture has thus a strong impact on surgical indication. There is a critique of the International Study about its materials that includes many patients with intracavernous carotid aneurysms, which appear to rupture less than intradural aneurysms. Further study would be necessary on this issue, because the figure may not represent the general patient population.

From our data, all aneurysms that bled during conservative management were 10 mm or larger, rupture was found in elderly patients. Risk of surgical intervention increases in these



Table 1 Patients with aneurysm rupture during follow-up

Case	Age	Sex	Location	Size (mm)	Symptom due to aneurysm	Systemic complication	Rupture from diagnosis	GOS
1	58	F	IC large	14	Asymptomatic	Keratoacanthosis of nose	1 year	SD
2	74	F	Vertebrobasilar	12	Asymptomatic	Cerebral infarction, myocardial infarction, DM	11 days	D
3	75	F	Right MCA	12	Asymptomatic	Cerebral infarction, arrhythmia	1 year	D
4	81	F	Bilateral MCA	10,7	Asymptomatic	none	5 months	D

DM = diabetes mellitus; GOS = Glasgow Outcome Scale; SD = severe disability; D = dead

cases, and endovascular treatment has been recently considered to be a valuable treatment option for them. Nowadays neurosurgeons should deliberate indication of treatment for unruptured aneurysms<sup>10</sup>, and should choose a better option for individual patients among conservative management, surgery, and endovascular approach as a less invasive treatment. Clinical decision analysis provides an aid to make more logical and objective choice in therapeutic strategy

### Conclusions

A retrospective study was conducted in a total of 128 patients with asymptomatic unruptured intracranial aneurysms. There was no mortality and 6.5% morbidity in 77 patients who underwent treatment for prevention of rupture. Outcome after endovascular treatment was excellent in four patients. Annual rupture rate was estimated at 2.7% in 51 patients during conservative management. Preventive surgery is justified for a Japanese 70 years or younger, from clinical decision analysis based on our own results. However its benefit de-

creases if the annual rupture rate is lower as 0.5% or 0.05%. Accurate rupture risk is essential for planning appropriate management.

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Table 2 Expected utility (full=100) in 70 year-old Japanese

Annual rupture rate	Conservative		Operation
	Male	Female	
2.7%	94.4	93.8	98.4
1%	97.8	97.5	
0.5%	98.9	98.7	
0.05%	99.9	99.9	

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